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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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In the Matter of)
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Rulemaking to Amend Part 1 and)
Part 21 of the Commission's Rules to)
Redesignate the 27.5-29.5 GHz Band and)
to Establish Rules and Policies for)
Local Multipoint Distribution Service)
and for Fixed Satellite Services)
)

CC Docket No. 92-297

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Comments of Northern Telecom Inc.

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SUMMARY

Northern Telecom Inc. ("Nortel") submits these comments on the Commission's Third NPRM addressing the allocation of the 28 GHz band. Nortel supports the Commission's efforts to allow both LMDS and satellite systems to use this spectrum. Nortel also supports the Commission's proposal to allocate 1,000 MHz to LMDS. Nortel additionally believes that based upon near term technology, the 1,000 MHz should be assigned to a single LMDS operator in each BTA market. Such an allocation and licensing scheme should allow LMDS to develop as a viable competitor to other broadband services.

Nortel believes that the proposal to split the LMDS band to permit frequency division duplexed operation of systems will allow systems to be rolled out rapidly, and so Nortel supports in general the concept of a band split as proposed by the Commission in the frequency ranges of 27.5 to 28.35 GHz and 29.1 to 29.25 GHz. Nortel is somewhat concerned, however, with the co-primary designation of the frequency range 29.1 to 29.25 GHz with MSS feeder links, and also concerned with that allocation scheme's dependence on the view that sharing is possible if subscriber transceivers do not transmit in this band.

The "sharing" restrictions imposed on LMDS in the 29.1 to 29.25 MHz band will make it difficult, if not impossible, to provide a full suite of broadcast as well as symmetric and asymmetric bi-directional narrowband and broadband services. Although some of the current LMDS proponents' systems could

operate with the restrictions, their offerings may not fulfill the promise of LMDS. Nortel believes that the Commission should adopt technical rules that anticipate advances in technology and more sophisticated LMDS systems.

In particular, Nortel believes that the Commission should not adopt the proposed EIRP limit of -52 dBW/Hz for the 27.5 to 28.35 GHz band. This limit, based on the current proposals, could preclude the deployment of higher efficiency modulation schemes, evolving high power transmitter technologies, and very high gain antennas. All of these advances in technology may be utilized to mitigate interference (including rain attenuation) and thus achieve high availability and high reliability broadband wireless access systems using LMDS spectrum. Nortel recommends that an EIRP of no less than -40 dBW/Hz be adopted to permit future systems with high capacities and performance to be introduced.

Nortel is also concerned that the proposed rules restricting EIRP in the 29.1 to 29.25 MHz band will make it impossible to deploy LMDS in a microcellular architecture. Nortel thus urges the Commission to consider a higher spectral power density limit for LMDS in this band, or alternatively the Commission could consider whether there is other spectrum that could be used for the LMDS return links.

Nortel believes that if the regulations are properly crafted, LMDS can be an important element of the information superhighway. LMDS will allow more efficient communications, and

will directly and indirectly lead to the creation of thousands of jobs. However, the Commission must adopt technical regulations that will allow this service to reach its full potential.

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In the Matter of

Rulemaking to Amend Part 1 and
Part 21 of the Commission's Rules to
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to Establish Rules and Policies for
Local Multipoint Distribution Service
and for Fixed Satellite Services

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Comments of Northern Telecom Inc.

Northern Telecom Inc. ("Nortel") hereby comments on some aspects of the Third Notice of Proposed Rulemaking in this proceeding to craft rules for the 28 GHz band.^{1/} As detailed below, Nortel agrees with the Commission that wireless systems operating in the 28 GHz band promise a significant opportunity for the rapid introduction of broadband services in a competitive environment. With the proper allocation of spectrum and the adoption of flexible service rules, local multipoint distribution service ("LMDS") systems could provide a vast combination of video programming, interactive video, and bi-directional voice

^{1/} Rulemaking to Amend Part 1 and Part 21 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Band and to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, FCC 95-287, released July 28, 1995 (hereafter "Third NPRM").

and data services for residential, institutional and business applications.

Nortel is one of the largest telecommunications equipment manufacturers in the United States, supplying systems to businesses, universities, local, state and federal governments, the telecommunications industry, and other institutions worldwide. The company employs more than 22,000 people in the United States in manufacturing plants, research and development centers, and in marketing, sales and service offices across the country.

As a manufacturer, Nortel is heavily involved in wireless services. Nortel is a leading manufacturer of mobile and fixed wireless as well as microwave radio systems. Nortel is the manufacturer of the infrastructure for North America's first commercial digital (IS-54 TDMA) cellular network, is co-developing a purpose-built fixed wireless access system that operates at microwave frequencies which is now undergoing trials, and has over 30 years of experience in the design of high capacity microwave products, including the world's most sophisticated system using 512-QAM modulation. Nortel's advanced microwave radio systems are now in operation in many countries throughout the world, and possess an unparalleled spectral efficiency of 8 bps/Hz along with a pace-setting quiescent error rate. Nortel believes that its extensive experience in wireless systems, in combination with its well recognized capabilities in network solutions for narrow and broad bandwidth telecommunications networks, permits it to provide valuable

comments to the Commission as it grapples with the issues surrounding spectrum allocation and service rules for LMDS. In that vein, Nortel offers the following general and specific responses to the LMDS issues raised in the Third NPRM.

As an initial matter, Nortel supports the Commission's decision to split the 28 GHz band among LMDS and satellite services. Nortel believes that the public interest will be advanced by accommodating terrestrial and satellite-based services in the 2 GHz available in the 28 GHz band. Sharing the band will permit the competitive development of both LMDS and satellite-based telecommunications systems.

Nortel also supports the Commission's decision to provide 1,000 MHz of spectrum for LMDS applications. Nortel believes that this amount will satisfy market requirements for services utilizing existing and near term technology developments.

According to studies undertaken by Bellcore, the most significant problem in the 28 GHz band will be achieving adequate signal coverage. At this point, insufficient work has been done to date for any organization accurately to quantify the performance of LMDS systems, particularly for potential LMDS offerings where availability and reliability are critical (such as traditional landline telephone service or medical imaging). Nortel believes that LMDS can ultimately support such services, but systems will be required to evolve as manufacturers and network operators gain experience in the design, deployment, and operation of this class of system.

Nortel therefore recommends that the allocation of 1,000 MHz for LMDS be granted to a single operator initially. As knowledge of the propagation environment evolves, and as millimeter wave and compression technologies mature, it may be possible at a later date to disaggregate the LMDS spectrum to support multiple operators without degrading the services offered by LMDS operators, and without adversely impacting LMDS' ability to compete against other technologies (such as cable television). Nortel likewise expects new services to emerge in the LMDS band as the technology evolves. In light of current plans and current technology, however, Nortel supports the Commission's proposal to allocate 1,000 MHz to LMDS, and to license a single LMDS service provider in each market.

Nortel additionally believes that splitting the LMDS band to permit frequency division duplexed operation of systems will advance the public interest by allowing a rapid roll-out of systems (and thus services) utilizing the spectrum with high efficiency. Thus, Nortel supports in general the concept of a band split as proposed by the Commission in the frequency ranges of 27.5 to 28.35 GHz and 29.1 to 29.25 GHz.^{2/}

Nortel is somewhat concerned, however, with the co-primary designation of the frequency range 29.1 to 29.25 GHz with MSS feeder links, and also concerned with that allocation

^{2/} Third NPRM at ¶ 47.

scheme's dependence on the view that sharing is possible if subscriber transceivers do not transmit in this band.^{3/}

Nortel fears that if this restriction on LMDS subscriber transceivers is maintained, the public interest may suffer. Many of the potential LMDS services that could help comprise the "information super highway" will not easily be facilitated if the Commission adopts the proposed restrictions on LMDS. Although the proposed rules will permit LMDS to be used for "wireless cable" or broadcast type services, other more robust offerings might not be possible. Nortel believes that these other possible broadband wireless access services could provide an alternative and competitive method of providing a broad range of services (including video, voice, and data), but that the proposed sharing rules will effectively foreclose such offerings.

Nortel does not think that the public would benefit fully from LMDS that was little more than another one-way "wireless cable" service. Spectrum has already been allocated, in the form of MMDS, for this purpose. Nortel believes that LMDS has the potential to provide a full service alternative to other broadband access systems that are evolving rapidly, and to provide full, two-way interactive services, potentially including competition in the local loop. LMDS systems thus have the potential to be an alternative for cable operators, the telephone

^{3/} Third NPRM at ¶ 60.

companies, and competitive access providers for the delivery of high quality competitive narrowband and broadband services.

Nortel is somewhat concerned about the proposal for co-primary sharing in the 29.1 to 29.25 GHz band. The Commission's proposal for sharing between LMDS and the satellite system feeder links apparently is based on the CellularVision technology.

CellularVision has asserted in its patent and published papers that its architecture can provide full bi-directional service within a contiguous allocation of spectrum by virtue of the use of a set of techniques including polarization re-use, directional subscriber antennas, and the use of frequency modulation.^{4/}

Nortel believes, however, based on its extensive experience in designing and deploying wireless systems and telecommunications networks, that the CellularVision system as described in its literature is not the best means of using the LMDS spectrum to provide a broad range of "broadcast" and bi-directional broadband services to residential subscribers in the present competitive environment.

Current networks are designed based on blocking probabilities, grades of service, and traffic and service profiles. Wireless access systems designed to meet these specifications utilize multiple access protocols to achieve spectral and network efficiency. LMDS systems will also need to incorporate features to efficiently support variable bandwidth services such as data and interactive video.

^{4/} United States Patent Number 4,747,160, Low Power Multi-Point Cellular System.

One alternative is to employ time division duplexing (TDD) with a multiple access protocol such as TDMA as currently employed in the European DECT cordless phone system. The difficulty with employing TDD is that (although quite effective in many bi-directional systems) it will be very inefficient in the delivery of broadcast services such as digital video programming, because information will be transmitted on a 50% duty cycle resulting in a 50% reduction in effective spectral efficiency. This duty cycle is required to mitigate intra-system interference when subscriber terminals are on a transmit cycle in the bi-directional service channels. The "upstream" time slots in the broadcast channels could be employed for expanded upstream traffic delivery, but due to the asymmetric nature of residential broadband services, this substantial amount of upstream capacity will likely not be required.

In systems that require more symmetric services, the use of TDD in the band 27.5 to 28.35 GHz can be considered practical. However, interference coordination between the two different types of systems would have to be taken into account at the service area boundaries and may be difficult to resolve. Nortel thus urges the Commission to adopt flexible technical rules for LMDS, so that operators can deploy the technology that will best be suited for their service offerings. The Commission should avoid technical rules which will restrict LMDS operators to CellularVision's technology.

Nortel is also concerned because the method of sharing the 29.1 to 29.25 GHz band as alluded to in Paragraph 63 of the

Third NPRM may be difficult to achieve in practice.^{5/} Nortel believes that the sharing method must be designed to operate in a more technologically diverse environment than the Third NPRM appears to envisage, since that approach may only work well for broadcast and low density two-way systems. Without further detailed technical studies being submitted into the record demonstrating compatibility for robust LMDS system architectures, Nortel cannot support the proposed sharing method for the 29.1 to 29.25 GHz band.

With respect to other aspects of the technical rules for LMDS, Nortel believes that LMDS systems providing a full array of broadcast and bi-directional services will be implemented using digital technology. Nortel supports the Commission's suggestion in Paragraph 118 of the Third NPRM that it need only adopt limited technical standards in order to facilitate coordination between geographically adjacent LMDS systems, and to facilitate coordination with MSS feeder link facilities where they share spectrum. Nortel believes that it may be necessary to further study operating characteristics in the 28 GHz band to quantify accurately the value of cross polarization discrimination for the purpose of coordinating at service area boundaries.

Nortel recommends to the Commission that it not limit the EIRP to -52 dBW/Hz for the band 27.5 to 28.35 GHz as proposed in Paragraph 123 of the Third NPRM. As the Commission recognizes

^{5/} Nortel addresses at pp. 10-11, infra, the system impacts of the EIRP limits.

in Paragraph 122, LMDS technologies are still evolving, and limiting the EIRP to the level of the highest of the currently proposed systems may preclude the use of higher efficiency modulation schemes, evolving high power transmitter technologies, and very high gain antennas. All of these advances in technology may be utilized to mitigate interference (including rain attenuation) and thus achieve high availability and high reliability broadband wireless access systems using LMDS spectrum. Nortel recommends that an EIRP of no less than -40 dBW/Hz be adopted to permit future systems with high capacities and performance to be introduced. Moreover, high levels of EIRP may permit the design of systems that can combat some level of foliage attenuation which will be required if ubiquity of service is a goal for LMDS. The greater permitted level of EIRP will also allow LMDS operators to operate part of their systems in a point-to-point configuration with the high link integrity required in network backbones.

Nortel believes that the proposed rule for EIRP for the allocation at 29.1 - 29.25 GHz limits the potential of LMDS systems deployed in these frequencies to the large cell base stations operating as wireless cable equivalent. Using the proposed formula for a new Section 21.1020 (set forth in the Third NPRM Appendix B),

$$EIRP_{Density} = 10 \log \left[\frac{1}{A} \sum_{i=1}^N P_i g_i \right] \frac{dBW}{MHz-km^2}$$

the requirements can be met with a 12 dB omnidirectional antenna with a 30 dBm (1 Watt) transmit power in a 20 MHz channel for Climate Zone 1 ($\text{EIRP}_{\text{Density}} \leq -23 \text{ dBW/MHz-km}^2$) as illustrated in Table 1 below.

Tx Power	Antenna Gain	Nominal Cell Radius	Number of Cells (A = 3000 km ²)	EIRP Density
30 dBm	12 dB	8 km	14	-24.3 dBW/MHz-km ²
30 dBm	16 dB	0.5 km	3464	+3.61 dBW/MHz-km ²

Table 1: Impact of EIRP Density Limits on LMDS Deployment Methods

By way of comparison, a hypothetical microcellular system using a 30 dBm transmit power in a 20 MHz channel and a sectorized antenna with 16 dB gain will exceed the EIRP density specification by nearly 26.6 dB. This excess over the specification by 26.6 dB can only be partially mitigated with the use of transmit power control. Assuming that only part of the BTA (20% for example) uses LMDS as the vehicle for broadband access, the EIRP spectral density (averaged over 3000 sq. km) is -3.38 dBW/MHz-km² (19.6 dB above the proposed limit for Climate Zone 1). The use of the frequency band 29.1 to 29.25 GHz for subscriber transmitter channels can produce substantially worse results than the case of microcellular broadband wireless base stations.

As noted in the Bellcore paper^{6/} the probability of receiving sufficient RF signal level from large cells even with the use of an antenna on a large mast at the subscriber residence could be poor. Due to the short range nature of the propagation characteristics in the 28 GHz band, LMDS is best suited to urban and suburban areas, or larger areas where the topographic features are relatively benign. If large cell sizes are employed which require elevated antennas to achieve a viable link (via line-of-sight), deployment of LMDS may be stifled.^{7/}

Since the EIRP limit made for this spectrum was driven by sharing requirements with MSS feeder links on a co-primary basis, Nortel recommends two options to the Commission for consideration:

- (1) The EIRP spectral density limits and methods proposed in Paragraph 123 and Appendix B imply extreme sensitivity of MSS feeder links to interference from LMDS. The literature describing different low-Earth orbit mobile satellite systems indicates that relatively few feeder links are required, so that the earth stations could be geographically located to mitigate susceptibility to interference from LMDS systems, thereby permitting a higher spectral power density.

^{6/} "28 GHz Local Multipoint Distribution Service (LMDS): Strengths and Challenges," S.Y. Seidel and H.W. Arnold, Bellcore, 1995.

^{7/} Zoning restrictions may limit the deployment of such "masts" by consumers. Moreover, even if not precluded by local regulations, the subscribers themselves are likely to object to deploying such aesthetically unappealing antennas on their property, particularly when contrasted with alternatives such as 18" DBS satellite dishes.

If further analysis indicates that this is not possible due to inadequate performance of either MSS or LMDS system, then Nortel proposes that

- (2) Alternative spectrum below 26.5 GHz be found for LMDS applications to provide a return link, possibly considering the release of unused spectrum currently assigned for other purposes. Alternatively, the MSS feeder link spectrum may be relocated to a more appropriate part of the spectrum.

Nortel does not believe that the Third NPRM's sharing proposal will allow the development of a robust LMDS that will be a viable competitor to other broadband systems.

Finally, with respect to some of the non-technical aspects of the LMDS proposals, Nortel agrees with the recommendation to use BTAs as the license territory. Such a market provides a large enough area to aggregate the cost of core networks required to provide interactive services over LMDS, thereby maintaining a potential cost competitiveness with other technologies such as hybrid fiber-coax and high speed twisted pair. Although Nortel supports the Commission's view, as expressed in Paragraph 117, that some build-out requirements are necessary for LMDS, Nortel believes that, at least initially, broadband access networks will be composed of several different technologies such as MMDS, LMDS fiber optics, hybrid fiber-coax, and high speed twisted-pair due to factors such as technological limitations and market forces. Nortel recommends that this phased deployment factor be taken into account in defining LMDS system build-out requirements.

In sum, Nortel believes that if the regulations are properly crafted, LMDS can be an important element of the information superhighway. LMDS will allow more efficient communications, and will directly and indirectly lead to the creation of thousands of new jobs. The Commission must be sure, however, that it adopts LMDS regulations that will allow this service to reach its full potential.

Respectfully Submitted,

A handwritten signature in dark ink, appearing to read "Stephen L. Goodman", is written over a horizontal line.

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